ART. XI.—*On Lightning Conductors generally, with special reference to the Conductor attached to the tower and spire of the Wesley Church, Melbourne.* By SIZAR ELLIOTT, Esq.

[Read before the Institute, 3rd August, 1859.]

MR. PRESIDENT AND GENTLEMEN,—

My attention to this subject (Lightning Conductors) arose from two causes. First, on the completion of the spire of the Wesley Church by the architect, Joseph Reed, Esq., a heavy thunderstorm passed over Melbourne, and feeling an interest in the building as an architectural embellishment to the city, I was led to look into the subject of its protection from lightning; and, secondly, from lately reading in one of the daily papers that the minister of a church in Castlemaine had contracted to have an iron rod erected as a protection from the electric fluid at a cost of five pounds. This arrangement, *i.e.*, an iron rod, appearing so deficient in the present advanced state of science, I considered it my duty to introduce the subject to your notice, so that a greater amount of information might be diffused among the public. I have, therefore, endeavored to make this paper as practical as possible, so that for the future our public buildings might be better protected than they are at present.

My authorities are Sir Snow Harris, Sir David Brewster, and others, all names well known to science.

The distinction between perfect and imperfect conductors rests in the time they require to convey the electric fluid to the earth. From experiments made, it appears that copper transmits the fluid in a thousandth part of the time that water does, and several thousand times quicker than dry stone. Iron, which is generally used, conducts the fluid twenty times slower than copper; and as the conductor, when in action, is thrown into vehement repulsion, it is necessary that there should be a considerable amount of strength employed to prevent disruption, and a considerable area, as the fluid travels only on the surface.

The rapidity of the transit, as estimated by Helvig, of Germany, is probably from eight to ten miles in a second.

In buildings having more than one spire, as is the case with the Wesley Church, therefore, each should be protected by a separate conductor, as it does not follow that the loftiest one would influence the discharge, for buildings have often been struck in one place when there was a conductor not far from the spot struck; and in cases of ships, the foremast has been struck when a lightning chain was employed at the mainmast. Under Sir S. Harris' arrangement, each mast is separately protected; so should it be with buildings having separate spires. The notion of keeping the conductors insulated from the building has been refuted, as it has been shown that the building itself conveys a large amount of fluid, and the use of the conductor is to assist, or give a continuous line of action; it should, therefore, be secured against the masonry, and not placed at any distance from the building, for it cannot be supposed that the fluid travelling with irresistible force and great rapidity, will leave a sufficient sized rod whether solid or hollow, or be diverted by an insignificant piece of glass, pitch, earthenware, or other insulating matter.

The external conductor of the Wesley Church, from the top of the spire to its termination in the ground, is composed of copper tubes one inch outside diameter, the metal of which is one-eighth of an inch thick. They are in about six feet lengths, joined together by screw-joints, over solid copper plugs, each six inches in length, the whole being securely fixed to the stonework by strong wrought iron wall hooks.

From the top of the spire to the level of the ground, the conductor measures one hundred and eighty feet; it is then continued to a depth of about three feet under ground, and further, in a nearly horizontal position, to a distance of about twelve feet from the walls of the tower, thus conveying the fluid quite clear of the edifice.

Above the apex of the spire the conductor is continued to a height of two feet six inches, by a solid copper rod three-quarters of an inch in diameter. Three forks, each nine inches long, branch from near the top, and at their junction with the rod are united by a solid copper ball, the whole of which above the termination of the spire is gilt, which renders it less visible, and does not interfere with the general proportions of the building.

The iron tie rods inside the spire being exposed to the electric fluid through the open dormers, it was considered necessary to attach a copper conductor to the same. From the ends of each of the iron rods and bars a copper tube one inch and a quarter in diameter has been fixed; these are connected together, and from them a copper rod one inch diameter passes down and out through one of the dormers to the outside conductor, with which it is connected.

The total cost of these conductors, fixed complete, internal and external, was about ninety pounds.

The ordinary construction of the rod has now been tried many years, and the accidents are as numerous as ever; but in the one just described we have nearly the most perfect rod that science has invented, and, I doubt not, as perfect as any conductor in this city.

I am, however, of opinion that the continuation of the conductor to its extreme point should have been of the same diameter as the longer portion of the rod, but as the reduced piece is only two feet six inches in length, it may not be of much importance. Another improvement that might probably have been made, would have been to have added another line of escape under ground; this opinion is founded on the practice of Sir S. Harris, who endeavours to make the escape not only direct, but by as many channels through ships' bottoms to the water as possible. One writer says he feels assured that if the ship's powder magazine were in the way, Sir S. Harris would not hesitate to convey the rod through it. I need hardly remark that bands of copper, where considered desirable, are just as efficacious as the rod, provided that requisite width, thickness, and solidity are kept in view; neither is it necessary that the conductor should be on the outside of the building; if found more convenient, it could be built in the walls or carried through the centre of the building. This mode is partially adopted in the column erected to the memory of Sir C. Hotham, in the New Cemetery; a portion of the conductor is passed behind the emblematical figures in the niches, and built in with the masonry. Neither do I think is it necessary to have more than one point of attraction.

Since the foregoing remarks were written, I have paid a visit to the Powder Magazine on Batman's Hill, where I find the old principle of small rods and wooden insulators still in use. The situation of the magazine, on the side of the hill and deep into the ground, is certainly favorable for security; but it is to the providence of the Almighty we have to attribute the safety of the city when an overcharged electric cloud passes over it, and not to the imperfect precautions taken to prevent such a calamity as the explosion of the magazine would produce.

The conductors in use at the magazine are not in accordance with the present advanced state of knowledge on the subject of electricity, and they ought not to be allowed to remain in their present imperfect condition. There is, however, another serious objection to the exposed situation of the hill on which the magazine is situated. An enemy coming up the river would have a good opportunity of lodging a well directed shot, when the calamity from the elements which we have heretofore escaped, might overtake us by the hand of man.

In conclusion, no further proof of the value of a good conductor need be given, than the fact that since Sir S. Harris' arrangement of band-copper conductors to Her Majesty's vessels of war, no material damage has been sustained by them, whilst under the old system of chains over the ship's side, from the top of the mast to the water, an incredible number of lives and much property were annually sacrificed.

Art. XII.—*On Dove's Law of the Turning of the Wind, as illustrated and supported by Observations made at the Flagstaff Meteorological and Magnetic Observatory, Melbourne.* By Professor George Neumayer, Government Meteorologist and Director of the Magnetic Survey of Victoria.

(With Four Plates.)

[Read before the Institute 31st August, 1859.]

Mr. President and Gentlemen,—

The subject I have chosen to bring before you is one replete with interest, both in a theoretical and in a practical point of view. It is one which is calculated to yield some aid to an understanding and a comprehension of the causes of the currents in our atmosphere. It shows how intimately connected these phenomena are, if traced to their origin, while the superficial observer sees in them irreconcilable and even conflicting facts. The law of the turning of the winds gives an additional proof that a careful examination of such facts, and a simple and clear reasoning, will put us in possession of the necessary premises whereupon to found our conclusions, even anticipating the existence of laws in nature which will sometime be demonstrated. As to the practical interest attached to investigations on the currents of our atmosphere, I do not need to dwell at any length, as